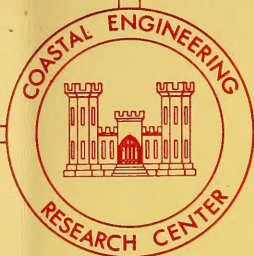
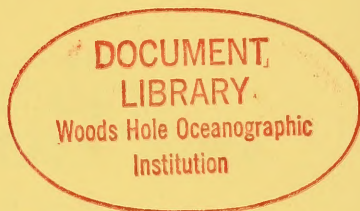


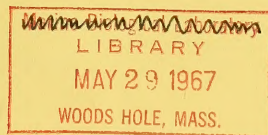
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U. S. Army Coastal Engineering Research Center



COMPILATION OF LONGSHORE CURRENT DATA



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COMPILATION OF LONGSHORE CURRENT DATA

by

Cyril J. Galvin and Richard A. Nelson



U.S. ARMY
COASTAL ENGINEERING RESEARCH CENTER

ABSTRACT

This paper is a compilation of published longshore current data available from North American sources as of January 1966. The data comprise 352 separate observations; of these 225 were obtained from four laboratory studies and 127 from four field studies. Each observation includes (at least) measured longshore current velocity, in feet per second; wave direction; a wave height, in feet; wave period, in seconds; and beach slope. Values of breaker height and breaker angle were computed for those observations lacking measured values. Longshore current velocity is usually less than 2 feet per second under both field and laboratory conditions. The maximum velocity observation from the field is 5.5 feet per second; from the laboratory 3.8 feet per second.

FOREWORD

Coastal engineers are examining longshore currents with increasing interest in the hope of predicting longshore current velocity from measurable characteristics of the waves and, eventually, the littoral transport rates that result from the flow of the currents. This compilation brings the available data together in a format that will be convenient to researchers. However, additional data are still needed, especially data accompanied by statistics of their variability and by a description of experimental procedure. Others working on this problem are invited to send copies of their published longshore current observations to CERC.

The paper was prepared by Cyril J. Galvin, Jr., Oceanographer, Research Division, U. S. Army Coastal Engineering Research Center, and Richard A. Nelson, graduate student, Department of Civil Engineering, Massachusetts Institute of Technology, assisted by J. D. Waggoner of the National Bureau of Standards.

At the time of publication, Colonel F. O. Diercks was Director of CERC, and J. M. Caldwell the Technical Director.

NOTE: Comments on this publication are invited. Discussion will be published in the next issue of the CERC Bulletin.

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COMPILATION OF LONGSHORE CURRENT DATA

by

Cyril J. Galvin, Jr. and Richard A. Nelson
Research Division
U. S. Army Coastal Engineering Research Center

1. Introduction

The principal goal of longshore current studies has been the prediction of longshore current velocity from measurable characteristics of the waves generating these currents. In order to test theoretical predictions of velocity or to calculate empirical predictions of velocity, data are necessary. Some data have been obtained and published in scattered journals. To make this data conveniently available, this article reprints, in standardized form, eight previously published sets of longshore current data, including four sets of field measurements (Putnam, Munk, and Traylor, 1949; Inman and Quinn, 1951; Moore and Scholl, 1961; Galvin and Savage, 1966)* and four sets of laboratory measurements (Putnam, Munk, and Traylor, 1949; Saville, 1950; Brebner and Kamphuis, 1963; Galvin and Eagleson, 1965). These data are presented in tables following the list of references.

These eight sets of data, obtained under varying conditions using differing experimental procedures, are not equally reliable. The purpose of this paper is to merely list the data in convenient format and to briefly describe how they were obtained as a background to the review and evaluation given by Galvin (1967). Because the available data cannot be easily evaluated, a secondary purpose of this paper is to suggest the full publication of experimental procedure and statistics indicating the reliability of the data obtained by future research.

2. Variables Listed

The eight sets of data, listed in the table, contain a total of 352 observations. A longshore current observation, for the purpose of this report, is the approximately simultaneous measurement of five variables: a mean longshore current velocity (VMEAS), in feet per second, the direction of the wave at breaking (THETAB) in degrees, the period of the breaking wave (TB) in seconds, the height of the breaking wave (HB) in feet, and the beach slope (SLOPE) dimensionless. These variables are defined in Figure 1. Other measurements in the table include mean water depth at the breaking point (DB) in feet, given with Putnam, Munk, and Traylor's laboratory data, the direction of the wave (THETA0) in degrees, and the height of the wave in deep water (HO) in feet, as computed by Saville and Brebner and Kamphuis for their laboratory data, and the horizontal distance from the breaking position to the stillwater line on the beach (BVAL) in feet,

* Parenthetical notations refer to LITERATURE CITED on page 8.

measured in the experiments of Galvin and Eagleson. In some of the eight studies additional information was obtained, and this is discussed in the description of each investigation given in paragraph 4.

In the tables, laboratory data are listed first, followed by field data, each in chronological order. The compilation of data in the tables is reasonably complete, but other published studies may exist, especially in foreign literature. Other unpublished data are known to exist (Johnson, 1953, and Harrison and Krumbejn, 1964), and field data obtained at Nags Head, North Carolina, by the Coastal Studies Institute of Louisiana State University (Sonu and McCloy, 1966).

The first column of the table is an identification number (ID) consisting of the initials of the investigators (as PMT), the letter L or F to indicate laboratory or field studies, and a number identifying the observation within the particular set of data. The last column of the table, labeled COUNT, is an identification number running from 1 to 352.

3. Difficulties in Measuring

Wave direction (THETAB) is the variable most difficult to measure with necessary accuracy. Visual field estimates are probably least reliable (Galvin and Savage, 1966) and even vertical photographs must have accurate horizontal control. The possibility of relative error increases markedly as THETAB decreases.

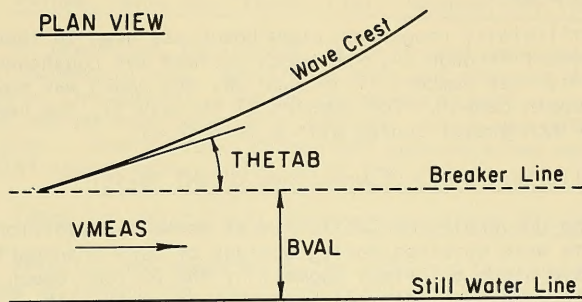
Longshore current velocity measurements (VMEAS) are more reliable than angle measurements, but this variable must be measured carefully because of the unsteadiness typical of field examples (Putnam, Munk, and Traylor, 1949) and the non-uniformity typical of laboratory examples (Brebner and Kamphuis, 1963; Galvin and Eagleson, 1965).

Wave height at breaking (HB) can be measured with reasonable accuracy, but care must be taken that measured values are representative. The wave gage must be fixed offshore of the mean breaking point and those waves which break before reaching the gage must be eliminated from the averages. Other problems arise because waves in nature have a finite crest length and are almost always subject to refraction effects; and on laboratory beaches, reflection causes partial standing waves which locally distort wave heights.

Wave period and beach slope can be measured within desirable accuracy under laboratory conditions. Under favorable conditions, wave period can be measured reasonably consistently in the field, either from oscillographs of the water surface or by visual observation. Well-controlled sounding from a pier permits accurate measurement of beach shape from which a slope may be defined. Similar sounding is necessary for laboratory sand beaches.

4. Descriptions of Investigations

The following paragraphs describe the peculiarities of each set of data, in the order that they are listed in the tables, based on



SIDE VIEW

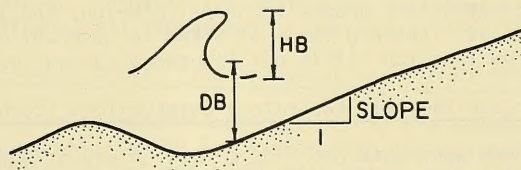


FIGURE 1. DEFINITION OF LONGSHORE
CURRENT VARIABLES

information obtained from the papers of the respective authors.

a. Putnam, Munk, and Traylor Laboratory Observations (COUNT 1-37)

At the University of California at Berkeley, longshore current velocity was measured by timing the travel of potassium permanganate (KMnO_4) dye on the central 10-foot section of a 39-foot (?) test beach. The breaker angle was obtained from vertical photographs, and wave height was measured by electric point gages.

A fixed, artificially roughened, plane beach was used in these experiments. For numbers 1 through 14, the beach surface was roughened by bonding natural sand to it. For numbers 15 through 28, the beach was covered with sheet metal or smooth cement. For numbers 29 through 37, the beach was covered with 1/4-inch gravel bonded with a thin grout.

b. Saville Laboratory Observations (COUNT 38-46)

At the University of California at Berkeley, additional longshore current data were obtained during a study of sand transport. The travel of KMnO_4 dye along a 10-foot segment of the 60-foot beach was timed to obtain velocity. Wave heights offshore were measured with point gages. Offshore of the surf zone, the beach was concrete, and inshore it was 0.3 mm sand. The slope listed in the table (0.10) is that of the concrete, but the slope in the surf zone may have been lower.

Breaker angle (THETAB) and breaker height (HB) were not measured, but the theoretical values in deep water (THETA0 and H0) were computed from small-amplitude wave theory. THETAB and HB were computed in this study for the table using refraction graphs (Johnson, O'Brien, and Isaacs, 1948) and (Le Mehaute, 1961). The zero value of VMEAS in observation number 46 (SAVL 9) is for a run in which little net longshore current was observed.

c. Brebner and Kamphuis Laboratory Observations (COUNT 47-187)

These data were obtained from a model study at Queens University, Kingston, Ontario, Canada. THETAB and HB were not measured, so the values listed in the table were also computed by using refraction graphs as for Saville's data. Velocity was measured by timing the travel of an immiscible, neutral-density fluid along the beach between 15 and 20 feet from the upstream wall. The concrete beach was at least 30 feet long and roughened by indentations spaced on one-inch centers. Offshore wave heights (not in table) were measured with an electric point gage.

d. Galvin and Eagleson Laboratory Observations (COUNT 188-225)

At the Massachusetts Institute of Technology, Hydrodynamics Laboratory, wooden floats and a current meter were used to measure longshore current velocity. The listed velocity is that observed at 18 feet from the upstream wall but considerable additional data are available on the two-dimensional velocity distribution in the surf zone, as well as

the distribution of setup over the whole beach. The overall beach was 30 feet long, of which 20 feet made up the test section. Most values of THETAB are the average of twenty measurements with a protractor. Wave height was measured with a parallel-wire resistance gage.

All blanks in the table for the data of Galvin and Eagleson indicate that the quantity was not measured.

e. Putnam, Munk, and Traylor Field Observations (COUNT 226-243)

At Oceanside, California, velocity was measured using weighted floats and fluorescein dye. Additional data was obtained showing the unsteadiness of the current. THETAB was measured with a compass from a pier or from photographs taken from a blimp. Slope was obtained by sounding from a pier. Observations 238 and 242 were obtained during a 22-knot following wind approximately parallel to the shore.

f. Inman and Quinn Field Observations (COUNT 244-276)

Velocity was measured at the water surface and at the bottom of the surf zone by timing the travel of floating kelp and weighted, tethered soccer balls. The velocities given by Inman and Quinn are already the averages of measurements made at 15 stations spaced at about 300-foot intervals at Torrey Pines and Pacific Beach (near La Jolla), California. Their statistics show that the standard deviations often exceed the mean velocity. In table 6, the velocity listed is the average of the bottom and surface velocities whenever both are given. HB was estimated by an observer on the beach. More than half of the values of THETAB were measured with a transit sighting bar. Zeros in the table mean that the variables, averaged over the 15 stations, had approximately zero magnitude.

g. Moore and Scholl Field Observations (COUNT 277-347)

Daily measurements were made during the summer of 1960 at Ogoturuk Beach, Alaska. THETAB was measured to the nearest 5° by compass, HB was estimated to the nearest tenth of a meter, and VMEAS in cm/sec with dye. Moore and Scholl's data, given originally in the metric system, are presented here in English units to conform with the other studies. SLOPE was not measured during the study and the value listed under SLOPE is a nominal one taken from a profile in their paper. The gravel beaches in this area produce steeper slopes than the sand beaches in the other field studies. Zeros listed in the table are measured values.

During observations numbered 285, 287, 295, 300, 302, and 322, the direction of the longshore current flow was opposite the direction from which the waves approached (indicated by minus signs on the velocity in the table).

h. Galvin and Savage Field Observations (COUNT 348-352)

At Nags Head, North Carolina, velocity was measured by timing the travel of balloons filled with freshwater. Most values of THETAB were

obtained by compass but some were also obtained by measuring the speed of the plunge point of the breaker or by crude triangulation. Wave height (HB) was measured visually or from oscillographs of the water surface. SLOPE was the average slope between the mean water line and a point 6 feet below mean water level. Other data include histograms showing the distribution of some of the measured variables from this CERC field project at Nags Head. THETAB in observation 352 is a single measurement at a time of changing wave conditions. VMEAS in observation 351 was small but not actually zero. Wind speed was high during nearly all the Nags Head measurements.

5. Discussion of Data

The data in the tables and the foregoing descriptions indicate differences among the sets of data. Among the laboratory studies, some differences are in the magnitude of the variables tested. For example, the laboratory conditions of Putnam, Munk, and Traylor are for conditions producing high values of VMEAS and THETAB. Of the 225 laboratory observations in the listing, six observations in the data of Putnam, Munk, and Traylor account for the six highest velocities (2.2 to 3.8 ft/sec) and the six highest breaker angles (39° to 38°). No value of THETAB in their laboratory experiments was less than 10° , but all of Saville's data, and most of the measurements of Galvin and Eagleson were for conditions producing THETAB less than 10° .

There are also differences in the variables which the investigators chose to measure. In the laboratory experiments of Saville and of Brebner and Kamphuis, THETAB and HB were not measured, but THETAO and HO were computed from offshore measurements instead. As explained in paragraph 4, the values of THETAB and HB for these two studies were newly computed for this paper; thus they will vary more regularly, yet they may be less accurate than actual measurement.

The experimental conditions of the laboratory tests also differ considerably. No two of the basins were alike in size and layout, and Saville's measurements were the only ones made on a deformable sand beach.

Large differences among the data from the field studies are also evident. The data of Inman and Quinn, although they provide useful statistics on variability, cannot be readily compared with other field measurements because their data are spatial averages along the beach. The data of Moore and Scholl are for lower waves, steeper beaches, and weaker currents than the other field studies. The few observations in the Nags Head study are accompanied by documented uncertainties, many of which were probably present in the other studies as well. Putnam, Munk, and Traylor velocities and Nags Head velocities are, on the average, significantly higher than in the other studies.

Viewed as a whole, the difference in magnitude between the laboratory and field data is greatest in wave height, and less for wave period and beach slope. Surprisingly, there is little difference between the average

magnitudes of the field and laboratory measurements of THETAB and VMEAS, despite the fact that wave heights differ by nearly two orders of magnitude.

Accurate measurement of longshore currents in the field and laboratory are still needed, particularly measurements of currents produced by conditions intermediate between laboratory and ocean wave conditions. The non-uniformity and unsteadiness of longshore currents should be studied under controlled laboratory conditions, including how they are affected by variations in the geometry of the laboratory basin. In future studies, more effort should be made to document the reliability of the experimental procedure and the variability of the data.

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TABLE I

LABORATORY DATA BY PUTNAM, MUNK, AND TRAYLOR

ID	HB FT	TB SEC	THETAB DEGREE'	SLOPE —	VMEAS FPS	DB FT	COUNT
PMTL 1	0.47	1.00	18.3	0.066	0.78	0.75	1
PMTL 2	0.32	1.06	13.8	0.066	0.64	0.44	2
PMTL 3	0.40	1.14	14.6	0.066	0.82	0.56	3
PMTL 4	0.31	1.15	12.6	0.066	0.68	0.41	4
PMTL 5	0.30	1.25	11.7	0.066	0.76	0.39	5
PMTL 6	0.32	1.32	11.7	0.066	0.75	0.40	6
PMTL 7	0.29	1.40	10.9	0.066	0.64	0.37	7
PMTL 8	0.16	1.90	17.6	0.144	0.75	0.24	8
PMTL 9	0.15	2.13	17.2	0.144	0.66	0.23	9
PMTL 10	0.15	2.22	17.3	0.144	0.50	0.24	10
PMTL 11	0.28	0.72	18.2	0.241	1.33	0.48	11
PMTL 12	0.35	0.92	16.5	0.241	1.27	0.52	12
PMTL 13	0.22	1.14	10.4	0.241	0.53	0.28	13
PMTL 14	0.22	1.22	10.6	0.241	0.69	0.27	14
PMTL 15	0.24	0.99	28.0	0.100	1.68	0.32	15
PMTL 16	0.22	1.32	22.8	0.100	1.45	0.27	16
PMTL 17	0.16	1.63	18.8	0.100	0.96	0.23	17
PMTL 18	0.16	1.98	18.4	0.100	0.76	0.22	18
PMTL 19	0.28	0.83	56.6	0.139	2.46	0.43	19
PMTL 20	0.23	0.91	45.3	0.139	2.31	0.33	20
PMTL 21	0.22	1.00	38.8	0.139	2.22	0.29	21
PMTL 22	0.20	1.12	33.2	0.139	1.93	0.24	22
PMTL 23	0.20	1.35	31.1	0.139	1.52	0.25	23
PMTL 24	0.34	0.80	57.5	0.260	3.78	0.62	24
PMTL 25	0.29	0.90	52.5	0.260	3.34	0.43	25
PMTL 26	0.28	0.98	47.2	0.260	3.00	0.41	26
PMTL 27	0.20	1.23	32.5	0.260	1.91	0.26	27
PMTL 28	0.22	1.27	31.9	0.260	1.76	0.23	28
PMTL 29	0.26	0.95	30.1	0.098	1.03	0.36	29
PMTL 30	0.21	1.33	21.4	0.098	0.46	0.27	30
PMTL 31	0.16	1.67	18.0	0.098	0.20	0.20	31
PMTL 32	0.12	1.99	16.4	0.098	0.15	0.19	32
PMTL 33	0.33	1.08	30.4	0.143	1.32	0.47	33
PMTL 34	0.29	1.36	24.6	0.143	0.63	0.38	34
PMTL 35	0.20	1.58	19.3	0.143	0.36	0.27	35
PMTL 36	0.20	1.91	18.4	0.143	0.32	0.26	36
PMTL 37	0.22	2.32	19.1	0.143	0.18	0.30	37

TABLE 2

LABORATORY DATA BY SAVILLE

ID	HB FT	HO FT	TB SEC	THETAB DEGREE	THETAO DEGREE	SLOPE	VMEAS FPS	COUNT
SAVL 1	0.147	0.146	0.71	7.7	10.0	0.10	0.32	38
SAVL 2	0.138	0.129	0.85	6.7	10.2	0.10	0.27	39
SAVL 3	0.132	0.116	0.94	6.3	10.5	0.10	0.25	40
SAVL 4	0.130	0.110	1.00	5.6	10.8	0.10	0.21	41
SAVL 5	0.171	0.169	0.74	7.2	10.0	0.10	0.40	42
SAVL 6	0.154	0.147	0.85	6.7	10.2	0.10	0.32	43
SAVL 7	0.144	0.126	0.99	5.6	10.7	0.10	0.24	44
SAVL 8	0.137	0.106	1.17	5.2	11.4	0.10	0.07	45
SAVL 9	0.127	0.082	1.50	4.7	13.1	0.10	0.00	46

TABLE 3

LABORATORY DATA BY BREBNER AND KAMPHUIS

ID		HB FT	HO FT	TB SEC	THETAB DEGREE	THETAO DEGREE	SLOPE	VMEAS FPS	COUNT
BKL	1	0.092	0.075	1.13	7.0	21.9	0.10	0.44	47
BKL	2	0.097	0.089	1.00	7.5	20.9	0.10	0.47	48
BKL	3	0.110	0.112	0.87	9.0	20.3	0.10	0.67	49
BKL	4	0.118	0.124	0.78	10.0	20.1	0.10	0.82	50
BKL	5	0.118	0.106	1.13	7.5	21.9	0.10	0.49	51
BKL	6	0.138	0.129	1.00	8.0	20.9	0.10	0.67	52
BKL	7	0.153	0.157	0.87	10.0	20.3	0.10	0.83	53
BKL	8	0.159	0.172	0.78	12.0	20.1	0.10	0.99	54
BKL	9	0.157	0.151	1.13	9.0	21.9	0.10	0.63	55
BKL	10	0.159	0.167	1.00	9.5	20.9	0.10	0.80	56
BKL	11	0.200	0.207	0.87	12.0	20.3	0.10	0.96	57
BKL	12	0.203	0.212	0.78	13.0	20.1	0.10	1.07	58
BKL	13	0.177	0.174	1.13	9.0	21.9	0.10	0.63	59
BKL	14	0.220	0.211	1.00	11.0	20.9	0.10	0.88	60
BKL	15	0.228	0.242	0.87	12.5	20.3	0.10	1.04	61
BKL	16	0.231	0.257	0.78	14.0	20.1	0.10	1.16	62
BKL	17	0.092	0.076	1.13	10.0	33.1	0.10	0.60	63
BKL	18	0.112	0.089	1.00	11.0	31.4	0.10	0.81	64
BKL	19	0.110	0.113	0.87	13.0	30.5	0.10	0.84	65
BKL	20	0.118	0.125	0.78	15.0	30.1	0.10	0.91	66
BKL	21	0.118	0.107	1.13	11.0	33.1	0.10	0.83	67
BKL	22	0.133	0.130	1.00	12.5	31.4	0.10	0.97	68
BKL	23	0.153	0.158	0.87	15.0	30.5	0.10	1.04	69
BKL	24	0.159	0.172	0.78	17.0	30.1	0.10	1.14	70
BKL	25	0.170	0.153	1.13	13.0	33.1	0.10	0.94	71
BKL	26	0.158	0.168	1.00	14.0	31.4	0.10	1.12	72
BKL	27	0.200	0.208	0.87	17.0	30.5	0.10	1.25	73
BKL	28	0.194	0.212	0.78	18.0	30.1	0.10	1.32	74
BKL	29	0.184	0.176	1.13	13.0	33.1	0.10	1.07	75
BKL	30	0.204	0.212	1.00	16.0	31.4	0.10	1.25	76
BKL	31	0.231	0.244	0.87	18.0	30.5	0.10	1.29	77
BKL	32	0.234	0.258	0.78	21.0	30.1	0.10	1.32	78
BKL	33	0.085	0.077	1.13	12.0	44.5	0.10	0.70	79
BKL	34	0.097	0.090	1.00	14.0	42.1	0.10	0.83	80
BKL	35	0.110	0.113	0.87	17.0	40.7	0.10	0.88	81
BKL	36	0.112	0.125	0.78	18.0	40.2	0.10	1.05	82
BKL	37	0.118	0.109	1.13	14.0	44.5	0.10	0.91	83
BKL	38	0.133	0.131	1.00	16.0	42.1	0.10	0.96	84
BKL	39	0.141	0.158	0.87	18.0	40.7	0.10	1.10	85
BKL	40	0.147	0.172	0.78	21.0	40.2	0.10	1.22	86
BKL	41	0.151	0.156	1.13	17.0	44.5	0.10	1.08	87
BKL	42	0.153	0.170	1.00	18.0	42.1	0.10	1.18	88
BKL	43	0.176	0.209	0.87	22.0	40.7	0.10	1.36	89
BKL	44	0.187	0.213	0.78	24.0	40.2	0.10	1.53	90
BKL	45	0.177	0.179	1.13	17.0	44.5	0.10	1.21	91

TABLE 3 (Continued)

ID	HB FT	HO FT	TB SEC	THETAB DEGREE	THETAO DEGREE	SLOPE	VMEAS FPS	COUNT
BKL 46	0.189	0.214	1.00	19.0	42.1	0.10	1.34	92
BKL 47	0.204	0.243	0.87	23.0	40.7	0.10	1.48	93
BKL 48	0.085	0.077	1.13	12.0	44.5	0.10	0.66	94
BKL 49	0.097	0.090	1.00	14.0	42.1	0.10	0.74	95
BKL 50	0.110	0.113	0.87	17.0	40.7	0.10	0.90	96
BKL 51	0.112	0.125	0.78	18.0	40.2	0.10	1.03	97
BKL 52	0.118	0.109	1.13	14.0	44.5	0.10	0.85	98
BKL 53	0.133	0.131	1.00	16.0	42.1	0.10	0.95	99
BKL 54	0.141	0.158	0.87	18.0	40.7	0.10	1.10	100
BKL 55	0.147	0.172	0.78	21.0	40.2	0.10	1.26	101
BKL 56	0.151	0.156	1.13	17.0	44.5	0.10	1.03	102
BKL 57	0.153	0.170	1.00	18.0	42.1	0.10	1.14	103
BKL 58	0.176	0.209	0.87	22.0	40.7	0.10	1.35	104
BKL 59	0.187	0.213	0.78	24.0	40.2	0.10	1.56	105
BKL 60	0.177	0.179	1.13	17.0	44.5	0.10	1.09	106
BKL 61	0.189	0.214	1.00	19.0	42.1	0.10	1.29	107
BKL 62	0.204	0.243	0.87	23.0	40.7	0.10	1.42	108
BKL 63	0.085	0.081	1.13	14.0	56.7	0.10	0.61	109
BKL 64	0.097	0.092	1.00	17.0	53.1	0.10	0.75	110
BKL 65	0.104	0.113	0.87	19.0	51.0	0.10	0.89	111
BKL 66	0.109	0.125	0.78	22.0	50.3	0.10	1.06	112
BKL 67	0.118	0.113	1.13	16.0	56.7	0.10	1.02	113
BKL 68	0.123	0.133	1.00	19.0	53.1	0.10	0.97	114
BKL 69	0.137	0.159	0.87	22.0	51.0	0.10	1.13	115
BKL 70	0.147	0.172	0.78	26.0	50.3	0.10	1.35	116
BKL 71	0.157	0.163	1.13	19.0	56.7	0.10	1.06	117
BKL 72	0.153	0.173	1.00	21.0	53.1	0.10	1.19	118
BKL 73	0.184	0.209	0.87	26.0	51.0	0.10	1.43	119
BKL 74	0.178	0.213	0.78	28.0	50.3	0.10	1.52	120
BKL 75	0.177	0.187	1.13	20.0	56.7	0.10	1.29	121
BKL 76	0.184	0.218	1.00	23.0	53.1	0.10	1.43	122
BKL 77	0.208	0.246	0.87	27.0	51.0	0.10	1.73	123
BKL 78	0.215	0.258	0.78	32.0	50.3	0.10	1.79	124
BKL 79	0.085	0.092	1.13	16.0	70.9	0.10	0.74	125
BKL 80	0.092	0.096	1.00	18.0	64.7	0.10	0.83	126
BKL 81	0.104	0.115	0.87	22.0	61.5	0.10	0.87	127
BKL 82	0.103	0.125	0.78	24.0	60.5	0.10	0.99	128
BKL 83	0.112	0.130	1.13	19.0	70.9	0.10	0.86	129
BKL 84	0.112	0.139	1.00	21.0	64.7	0.10	1.01	130
BKL 85	0.129	0.161	0.87	25.0	61.5	0.10	1.10	131
BKL 86	0.140	0.173	0.78	28.0	60.5	0.10	1.25	132
BKL 87	0.138	0.186	1.13	21.0	70.9	0.10	1.03	133
BKL 88	0.143	0.180	1.00	23.0	64.7	0.10	1.15	134
BKL 89	0.172	0.212	0.87	28.0	61.5	0.10	1.28	135
BKL 90	0.169	0.214	0.78	31.0	60.5	0.10	1.48	136
BKL 91	0.151	0.214	1.13	22.0	70.9	0.10	1.12	137
BKL 92	0.179	0.227	1.00	26.0	64.7	0.10	1.27	138
BKL 93	0.192	0.248	0.87	30.0	61.5	0.10	1.42	139

TABLE 3 (Continued)

ID	HB FT	HO FT	TB SEC	THETAB DEGREE	THETAO DEGREE	SLOPE	VMEAS FPS	COUNT
BKL 94	0.203	0.259	0.78	35.0	60.5	0.10	1.66	140
BKL 95	0.092	0.075	1.13	7.0	21.9	0.05	0.49	141
BKL 96	0.097	0.089	1.00	7.5	20.9	0.05	0.56	142
BKL 97	0.110	0.112	0.87	9.0	20.3	0.05	0.62	143
BKL 98	0.118	0.124	0.78	10.0	20.1	0.05	0.68	144
BKL 99	0.118	0.106	1.13	7.5	21.9	0.05	0.66	145
BKL 100	0.138	0.129	1.00	8.0	20.9	0.05	0.61	146
BKL 101	0.153	0.157	0.87	10.0	20.3	0.05	0.67	147
BKL 102	0.159	0.172	0.78	12.0	20.1	0.05	0.69	148
BKL 103	0.157	0.151	1.13	9.0	21.9	0.05	0.71	149
BKL 104	0.159	0.167	1.00	9.5	20.9	0.05	0.73	150
BKL 105	0.200	0.207	0.87	12.0	20.3	0.05	0.80	151
BKL 106	0.203	0.212	0.78	13.0	20.1	0.05	0.81	152
BKL 107	0.177	0.174	1.13	9.0	21.9	0.05	0.84	153
BKL 108	0.220	0.211	1.00	11.0	20.9	0.05	0.80	154
BKL 109	0.228	0.242	0.87	12.5	20.3	0.05	0.82	155
BKL 110	0.231	0.257	0.78	14.0	20.1	0.05	0.84	156
BKL 111	0.092	0.076	1.13	10.0	33.1	0.05	0.63	157
BKL 112	0.112	0.089	1.00	11.0	31.4	0.05	0.61	158
BKL 113	0.110	0.113	0.87	13.0	30.5	0.15	0.65	159
BKL 114	0.118	0.125	0.78	15.0	30.1	0.05	0.64	160
BKL 115	0.118	0.107	1.13	11.0	33.1	0.05	0.76	161
BKL 116	0.133	0.130	1.00	12.5	31.4	0.05	0.68	162
BKL 117	0.153	0.158	0.87	15.0	30.5	0.05	0.76	163
BKL 118	0.159	0.172	0.78	17.0	30.1	0.05	0.78	164
BKL 119	0.170	0.153	1.13	13.0	33.1	0.05	0.86	165
BKL 120	0.158	0.168	1.00	14.0	31.4	0.05	0.78	166
BKL 121	0.200	0.208	0.87	17.0	30.5	0.05	0.90	167
BKL 122	0.194	0.212	0.78	18.0	30.1	0.05	0.90	168
BKL 123	0.184	0.176	1.13	13.0	33.1	0.05	0.96	169
BKL 124	0.204	0.212	1.00	16.0	31.4	0.05	0.92	170
BKL 125	0.231	0.244	0.87	18.0	30.5	0.05	0.98	171
BKL 126	0.234	0.258	0.78	21.0	30.1	0.05	1.03	172
BKL 127	0.085	0.077	1.13	12.0	44.5	0.05	0.66	173
BKL 128	0.097	0.090	1.00	14.0	42.1	0.05	0.80	174
BKL 129	0.110	0.113	0.87	17.0	40.7	0.05	0.68	175
BKL 130	0.112	0.125	0.78	18.0	40.2	0.05	0.83	176
BKL 131	0.118	0.109	1.13	14.0	44.5	0.05	0.79	177
BKL 132	0.133	0.131	1.00	16.0	42.1	0.05	0.89	178
BKL 133	0.141	0.158	0.87	18.0	40.7	0.05	1.00	179
BKL 134	0.147	0.172	0.78	21.0	40.2	0.05	1.07	180
BKL 135	0.151	0.156	1.13	17.0	44.5	0.05	0.87	181
BKL 136	0.153	0.170	1.00	18.0	42.1	0.05	1.07	182
BKL 137	0.176	0.209	0.87	22.0	40.7	0.05	1.04	183
BKL 138	0.187	0.213	0.78	24.0	40.2	0.05	1.12	184
BKL 139	0.177	0.179	1.13	17.0	44.5	0.05	1.06	185
BKL 140	0.189	0.214	1.00	19.0	42.1	0.05	1.07	186
BKL 141	0.204	0.243	0.87	23.0	40.7	0.05	1.15	187

TABLE 4

LABORATORY DATA BY GALVIN AND EAGLESON

ID	HB FT	TB SEC	THETAB DEGREE	SLOPE	BVAL FT	VMEAS FPS	COUNT
GEL 1	----	1.00	5.4	0.109	0.83	1.62	188
GEL 2	0.21	1.12	5.1	0.109	0.82	1.53	189
GEL 3	0.14	1.25	3.3	0.109	0.68	1.33	190
GEL 4	0.19	1.37	2.3	0.109	0.53	1.24	191
GEL 5	----	1.50	3.7	0.109	0.52	1.17	192
GEL 6	0.03	1.25	2.6	0.109	0.34	0.62	193
GEL 7	0.12	1.25	3.1	0.109	0.50	0.87	194
GEL 8	0.17	1.25	3.8	0.109	0.67	1.21	195
GEL 9	0.17	1.25	3.7	0.109	0.71	1.07	196
GEL 10	0.19	1.25	4.0	0.109	0.84	1.44	197
GEL 11	0.07	1.50	1.1	0.109	0.21	0.76	198
GEL 12	0.09	1.00	2.9	0.109	0.45	0.98	199
GEL 13	0.18	0.90	---	0.109	1.81	----	200
GEL 14	0.17	1.00	14.1	0.109	1.76	1.52	201
GEL 15	0.19	1.12	12.1	0.109	1.60	1.51	202
GEL 16	0.19	1.25	10.1	0.109	1.61	1.44	203
GEL 17	0.19	1.37	9.2	0.109	1.42	1.13	204
GEL 18	0.16	1.50	6.9	0.109	1.23	1.04	205
GEL 19	0.09	1.25	6.1	0.109	0.56	0.68	206
GEL 20	0.13	1.25	6.6	0.109	0.96	0.85	207
GEL 21	0.15	1.25	8.6	0.109	1.23	1.11	208
GEL 22	0.17	1.25	9.8	0.109	1.49	1.33	209
GEL 23	0.17	1.25	11.0	0.109	1.77	1.55	210
GEL 24	0.11	1.50	3.7	0.109	----	0.77	211
GEL 25	0.11	1.00	9.7	0.109	----	0.94	212
GEL 26	0.18	1.00	28.0	0.109	2.15	1.40	213
GEL 27	----	1.12	21.8	0.109	1.89	1.15	214
GEL 28	0.19	1.25	18.6	0.109	1.91	1.22	215
GEL 29	----	1.37	15.7	0.109	1.81	1.32	216
GEL 30	0.10	1.50	8.6	0.109	0.91	0.91	217
GEL 31	0.16	1.25	13.3	0.109	0.65	0.69	218
GEL 32	0.13	1.25	14.3	0.109	1.20	0.83	219
GEL 33	0.16	1.25	19.6	0.109	1.57	1.19	220
GEL 34	----	1.25	19.6	0.109	1.88	1.27	221
GEL 35	----	1.25	22.5	0.109	1.96	1.29	222
GEL 36	----	1.50	6.0	0.109	0.18	0.57	223
GEL 37	----	1.00	20.1	0.109	1.46	0.88	224
GEL 38	----	1.00	18.9	0.109	----	1.11	225

TABLE 5

FIELD DATA BY PUTNAM, MUNK, AND TRAYLOR

ID		HB FT	TB SEC	THETAB DEGREE	SLOPE	VMEAS FPS	COUNT
PMTF	1	5.0	10.0	15.0	0.016	2.5	226
PMTF	2	5.5	9.0	12.0	0.020	2.2	227
PMTF	3	7.0	9.0	15.0	0.023	3.0	228
PMTF	4	6.0	7.0	7.5	0.017	1.8	229
PMTF	5	5.0	10.0	10.0	0.031	3.6	230
PMTF	6	8.0	10.0	10.0	0.022	2.8	231
PMTF	7	8.0	10.0	10.0	0.023	2.3	232
PMTF	8	6.5	12.0	10.0	0.020	2.4	233
PMTF	9	4.5	12.0	10.0	0.020	2.4	234
PMTF	10	4.5	12.0	10.0	0.019	2.7	235
PMTF	11	4.5	12.0	10.0	0.019	2.1	236
PMTF	12	6.5	15.0	5.0	0.016	1.7	237
PMTF	13	8.0	7.0	17.5	0.022	5.2	238
PMTF	14	5.0	8.0	10.0	0.030	3.3	239
PMTF	15	8.5	8.0	12.0	0.020	2.5	240
PMTF	16	5.0	15.0	5.0	0.026	2.4	241
PMTF	17	9.0	8.0	15.0	0.019	5.5	242
PMTF	18	9.0	8.0	15.0	0.019	3.9	243

TABLE 6

FIELD DATA BY INMAN AND QUINN

ID	HB FT	TB SEC	THETAB DEGREE	SLOPE	VMEAS FPS	COUNT
IQF 1	2.8	15.0	6.5	0.027	0.38	244
IQF 2	3.1	8.5	1.5	0.027	0.04	245
IQF 3	3.7	8.0	4.0	0.027	0.22	246
IQF 4	3.6	14.0	0.	0.027	0.04	247
IQF 5	4.9	8.0	5.0	0.027	0.84	248
IQF 6	3.8	7.0	5.0	0.027	0.21	249
IQF 7	3.4	12.5	0.	0.027	0.55	250
IQF 8	2.6	8.0	0.	0.035	0.04	251
IQF 9	3.0	9.5	1.0	0.035	0.01	252
IQF 10	2.7	10.0	0.	0.035	0.15	253
IQF 11	3.5	13.5	0.	0.035	0.09	254
IQF 12	4.9	13.0	0.	0.035	0.21	255
IQF 13	2.9	10.0	0.	0.035	0.50	256
IQF 14	4.6	12.0	0.	0.035	0.88	257
IQF 15	3.7	8.0	0.	0.028	0.20	258
IQF 16	5.1	12.0	6.0	0.027	0.29	259
IQF 17	4.7	14.0	7.0	0.027	0.53	260
IQF 18	4.5	15.0	4.0	0.027	0.70	261
IQF 19	4.8	12.0	4.0	0.027	1.19	262
IQF 20	4.2	12.0	4.5	0.027	0.40	263
IQF 21	2.0	12.0	4.0	0.027	0.36	264
IQF 22	1.7	8.0	7.0	0.027	0.23	265
IQF 23	2.9	15.0	5.0	0.027	0.56	266
IQF 24	1.6	6.0	5.0	0.027	0.11	267
IQF 25	6.2	14.0	5.0	0.014	0.54	268
IQF 26	3.1	16.0	7.0	0.014	0.62	269
IQF 27	4.5	12.0	3.0	0.014	0.49	270
IQF 28	3.5	14.0	4.0	0.014	0.17	271
IQF 29	2.7	16.0	3.5	0.014	0.13	272
IQF 30	4.7	13.0	7.0	0.014	1.37	273
IQF 31	2.6	11.5	2.0	0.014	0.04	274
IQF 32	2.0	14.5	4.0	0.014	0.11	275
IQF 33	1.8	12.0	2.5	0.014	0.06	276

TABLE 7

FIELD DATA BY MOORE AND SCHOLL

ID	HB FT	TB SEC	THETAB DEGREE	SLOPE	VMEAS FPS	COUNT
MSF 1	0.66	2.5	35	0.2	0.16	277
MSF 2	0.66	2.7	25	0.2	0.	278
MSF 3	0.98	2.6	40	0.2	0.	279
MSF 4	0.66	2.6	5	0.2	0.29	280
MSF 5	0.66	3.3	5	0.2	0.26	281
MSF 6	1.97	5.0	5	0.2	0.66	282
MSF 7	1.64	4.8	5	0.2	0.49	283
MSF 8	1.31	4.3 v	10	0.2	0.36	284
MSF 9	1.64	4.0	20	0.2	-0.13	285
MSF 10	0.66	2.7	35	0.2	0.66	286
MSF 11	0.33	3.5	5	0.2	0.49	287
MSF 12	0.66	5.5	10	0.2	0.16	288
MSF 13	0.98	3.5	5	0.2	0.10	289
MSF 14	4.59	6.0	5	0.2	0.75	290
MSF 15	0.98	4.0	5	0.2	0.03	291
MSF 16	0.33	6.5	0	0.2	0.	292
MSF 17	0.33	5.0	0	0.2	0.16	293
MSF 18	0.33	7.1	5	0.2	0.10	294
MSF 19	0.66	4.5	10	0.2	-0.07	295
MSF 20	0.33	4.5	0	0.2	0.	296
MSF 21	0.33	5.5	5	0.2	0.36	297
MSF 22	0.33	4.3	5	0.2	0.	298
MSF 23	0.98	4.1	15	0.2	0.20	299
MSF 24	1.31	4.4	25	0.2	-0.82	300
MSF 25	0.98	4.4	20	0.2	0.20	301
MSF 26	0.66	4.4	10	0.2	-0.07	302
MSF 27	3.94	4.4	5	0.2	0.95	303
MSF 28	4.59	5.8	5	0.2	0.26	304
MSF 29	3.61	5.5	-0	0.2	-0.	305
MSF 30	1.97	5.5	-0	0.2	0.13	306
MSF 31	0.66	5.0	-0	0.2	0.03	307
MSF 32	0.66	7.5	-0	0.2	0.13	308
MSF 33	0.33	7.0	-0	0.2	0.16	309
MSF 34	0.33	7.1	-0	0.2	0.	310
MSF 35	0.33	5.5	-0	0.2	0.	311
MSF 36	0.33	5.3	5	0.2	0.10	312
MSF 37	0.33	5.3	-0	0.2	-0.	313
MSF 38	0.33	5.0	5	0.2	0.26	314
MSF 39	0.33	6.0	15	0.2	-0.	315
MSF 40	0.66	2.5	20	0.2	0.20	316
MSF 41	1.64	3.5	5	0.2	0.16	317
MSF 42	5.90	5.5	0	0.2	0.52	318
MSF 43	2.96	5.0	5	0.2	0.95	319
MSF 44	1.64	7.0	20	0.2	0.92	320

TABLE 7 (Continued)

ID	HB FT	TB SEC	THETAB DEGREE	SLOPE	VMEAS FPS	COUNT
MSF 45	2.62	6.0	25	0.2	1.38	321
MSF 46	0.66	7.0	15	0.2	-0.10	322
MSF 47	0.33	5.0	-0	0.2	-0.	323
MSF 48	0.33	6.0	5	0.2	-0.33	324
MSF 49	0.66	4.5	5	0.2	-0.	325
MSF 50	0.98	2.5	5	0.2	0.46	326
MSF 51	0.98	4.4	-0	0.2	0.16	327
MSF 52	1.64	3.3	10	0.2	0.69	328
MSF 53	0.66	4.0	-0	0.2	-0.	329
MSF 54	0.98	4.0	30	0.2	0.10	330
MSF 55	2.96	4.5	20	0.2	0.49	331
MSF 56	1.97	5.0	45	0.2	1.25	332
MSF 57	0.66	1.0	-0	0.2	0.16	333
MSF 58	1.97	4.0	20	0.2	0.98	334
MSF 59	1.97	3.9	30	0.2	1.21	335
MSF 60	3.94	5.0	20	0.2	0.75	336
MSF 61	4.92	4.0	10	0.2	1.18	337
MSF 62	1.97	4.0	45	0.2	1.41	338
MSF 63	0.98	4.6	10	0.2	0.10	339
MSF 64	5.91	4.0	30	0.2	1.21	340
MSF 65	2.96	1.0	20	0.2	0.49	341
MSF 66	2.96	2.3	20	0.2	0.16	342
MSF 67	3.94	4.0	20	0.2	0.75	343
MSF 68	5.91	4.2	10	0.2	0.98	344
MSF 69	0.98	3.6	20	0.2	0.07	345
MSF 70	2.96	4.0	20	0.2	0.33	346
MSF 71	5.91	3.6	30	0.2	0.98	347

TABLE 8

FIELD OBSERVATIONS BY GALVIN AND SAVAGE

ID	HB FT	TB SEC	THETAB DEGREE	SLOPE	VMEAS FPS	COUNT
GSF 1	2.0	5.2	19.5	0.030	2.42	348
GSF 2	3.2	9.9	19.0	0.026	4.33	349
GSF 3	1.8	5.9	11.0	0.029	1.96	350
GSF 4	1.5	8.8	3.2	0.027	0.	351
GSF 5	8.0	12.3	12.0	0.026	1.27	352

<p>U. S. ARMY COASTAL ENGRG RESEARCH CENTER, CE WASHINGTON, D. C.</p> <p>COMPILATION OF LONGSHORE CURRENT DATA by Cyril J. Galvin, Jr. and Richard A. Nelson March 1967. 19 pp. Including 1 figure and 8 tables.</p> <p>MISCELLANEOUS PAPER 2-67 <u>UNCLASSIFIED</u></p> <p>A compilation of published longshore current data comprising 352 separate observations; 225 from four laboratory studies, and 127 from four field studies. Eight tables of data include measured longshore current velocity, wave direction, wave height, wave period and beach slope.</p>	<p>U. S. ARMY COASTAL ENGRG RESEARCH CENTER, CE WASHINGTON, D. C.</p> <p>COMPILATION OF LONGSHORE CURRENT DATA by Cyril J. Galvin, Jr. and Richard A. Nelson March 1967. 19 pp. Including 1 figure and 8 tables.</p> <p>MISCELLANEOUS PAPER 2-67 <u>UNCLASSIFIED</u></p> <p>A compilation of published longshore current data comprising 352 separate observations; 225 from four laboratory studies, and 127 from four field studies. Eight tables of data include measured longshore current velocity, wave direction, wave height, wave period and beach slope.</p>	<p>U. S. ARMY COASTAL ENGRG RESEARCH CENTER, CE WASHINGTON, D. C.</p> <p>COMPILATION OF LONGSHORE CURRENT DATA by Cyril J. Galvin, Jr. and Richard A. Nelson March 1967. 19 pp. Including 1 figure and 8 tables.</p> <p>MISCELLANEOUS PAPER 2-67 <u>UNCLASSIFIED</u></p> <p>A compilation of published longshore current data comprising 352 separate observations; 225 from four laboratory studies, and 127 from four field studies. Eight tables of data include measured longshore current velocity, wave direction, wave height, wave period and beach slope.</p>	<p>U. S. ARMY COASTAL ENGRG RESEARCH CENTER, CE WASHINGTON, D. C.</p> <p>COMPILATION OF LONGSHORE CURRENT DATA by Cyril J. Galvin, Jr. and Richard A. Nelson March 1967. 19 pp. Including 1 figure and 8 tables.</p> <p>MISCELLANEOUS PAPER 2-67 <u>UNCLASSIFIED</u></p> <p>A compilation of published longshore current data comprising 352 separate observations; 225 from four laboratory studies, and 127 from four field studies. Eight tables of data include measured longshore current velocity, wave direction, wave height, wave period and beach slope.</p>
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